Algorithmic Method and Computer System for Synthesizing
Self-Healing Networks, Bus Structures, and Connectivities

Drawing
sheet
1 / 4

L. E. LaForge and K. F. Korver
+1.775.322.5186

#4

ARCHITECTURE CREATION

Total Number of Elements   36

Number of Faults Tolerated   3

OK   Cancel

1

CHOOSE ARCHITECTURE TO SYNTHESIZE

Description	Min Radius	Max Radius	Recommend
2-dimensional 6-ary C-cube	6	8	No
1-dimensional 3-ary K-cube-connected cycle, each cycle with 12 elements	7	7	No
2-dimensional 2-ary K-cube-connected cycle, each cycle with 9 elements	6	7	Yes

Synthesize   Cancel

2

3

4

K-CUBE CONNECTED CYCLE 6A - STA ARCHITECTURE

FILE   EDIT   VIEW   CREATE   FAULT DISTRIBUTIONS   CALCULATE   INFORMATION   HELP

CONNECTED COMPONENTS
MAX FLOW PATHS
DIAGNOSE INSTANCE WITH MTAD

5a, b

6a, b

1,0,8   1,1,8

0,0,8   0,1,8

1,0,0   1,1,0

0,0,1

0,0,0   0,1,0

2-DIMENSIONAL 2-ARY K-CUBE-CONNECTED CYCLE, EACH CYCLE WITH 9 ELEMENTS   NUM

FLOW

Maximum dataflow

2   OK

CONNECTED COMPONENT PROPERTIES

Number of Elements   36

Diameter   6

Radius   6

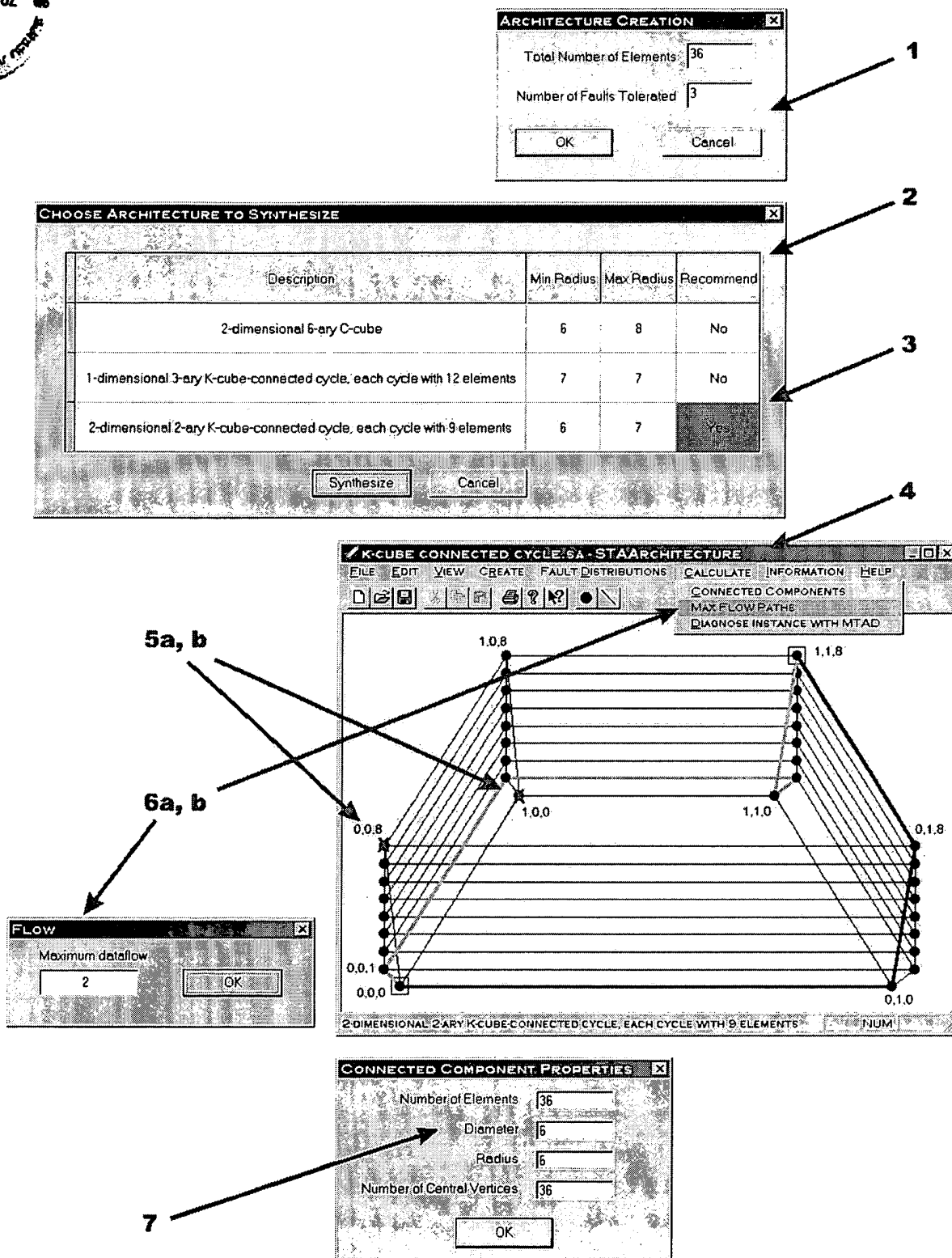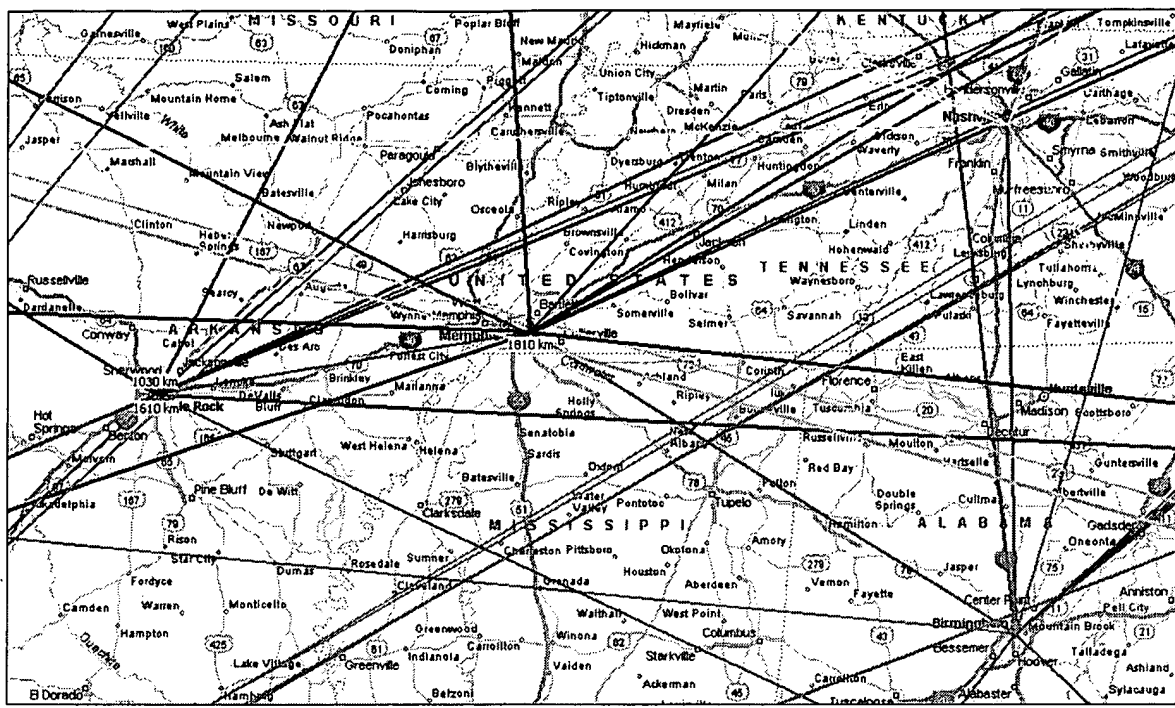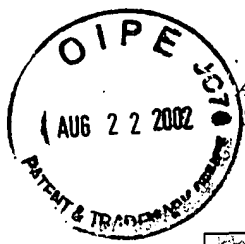Number of Central Vertices   36

OK

7

FIG. 1

FIG. 2A

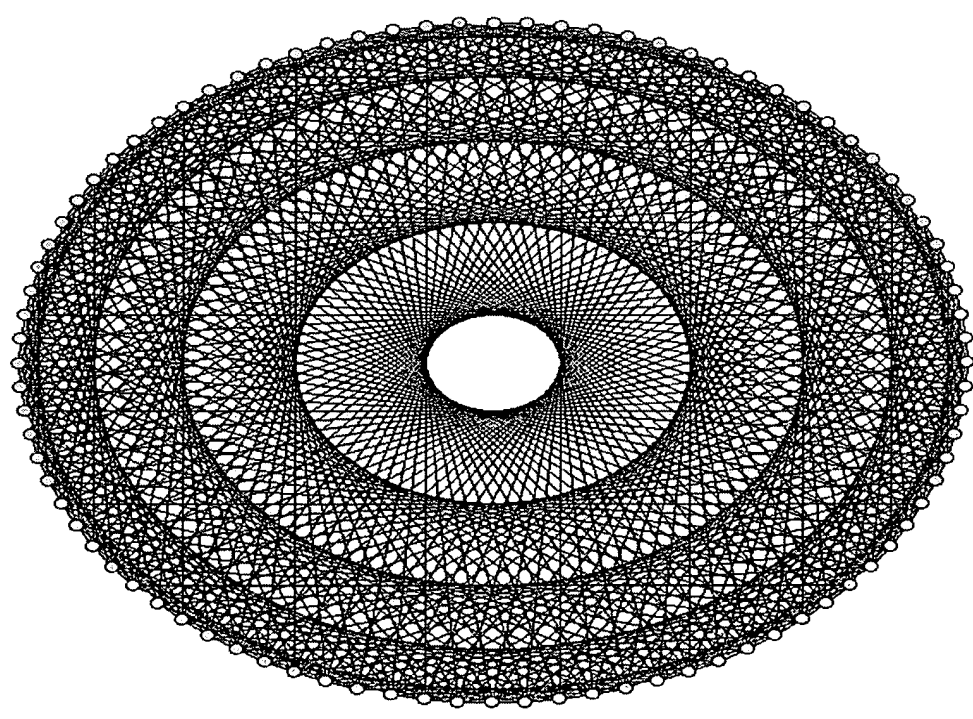FIG 2B

Number of Faults Tolerated: Nodes or Nodes+Channels	Fractional 1+ Fault Tolerance $p_{wc} = f+1$	Fewest Number of Channels per GovNet Node	Total Number of Channels in GovNet (Least Possible)	Example f-tolerant Connectivity with Fewest Channels
0	1.14%	1.99	87	Any 88-node tree
1	2.27%	2	88	Cycle, a.k.a. ring (unique)
2	3.41%	3	132	K-cube-connected cycle
4	5.68%	5	220	K-cube-connected cycle
8	10.23%	9	396	(4,4) cordal cycle
11	13.64%	12	528	K-cube-connected cycle
16	19.32%	17	748	Locally spared 2D K-mesh
86	98.86%	87	3828	Clique (unique)

FIG. 3A

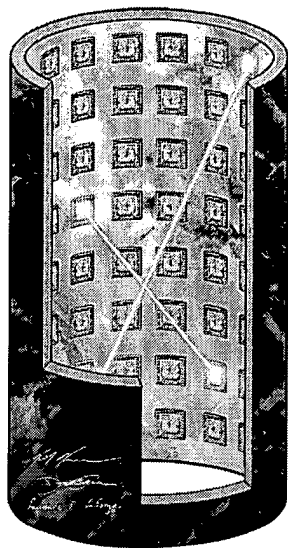| Fractional Fault Tolerance Bernoulli p or Worst Case p_{wc}		Channels per GovNet Node		Total Number of Channels in GovNet	
		Probabilistic	Worst Case	Probabilistic	Worst Case
10.22%	(8 faults)	8	9	352	396
13.64%	(11 faults)	8	12	352	528
19.31%	(16 faults)	10	17	440	748

FIG. 3B

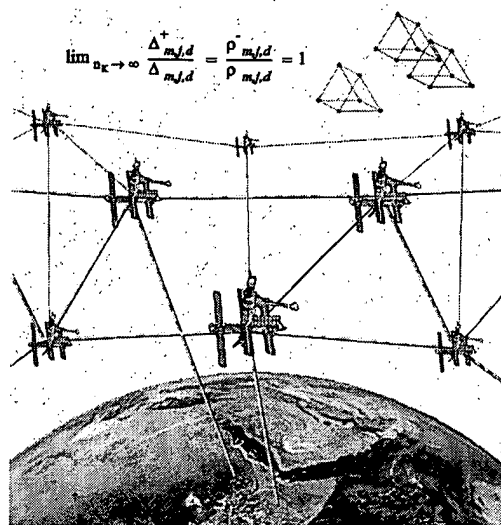| Bernoulli Fault Tolerance p	Average Number of Channels per GovNet Node		Total Number of Channels in GovNet		Worst Case Fault Tolerance f	
	Regular	Irregular	Regular	Irregular	Regular	Irregular
10.22%	8	1.95	352	172	7	1
13.64%	8	1.95	352	172	7	1
19.31%	10	1.95	440	172	9	1

FIG. 3C

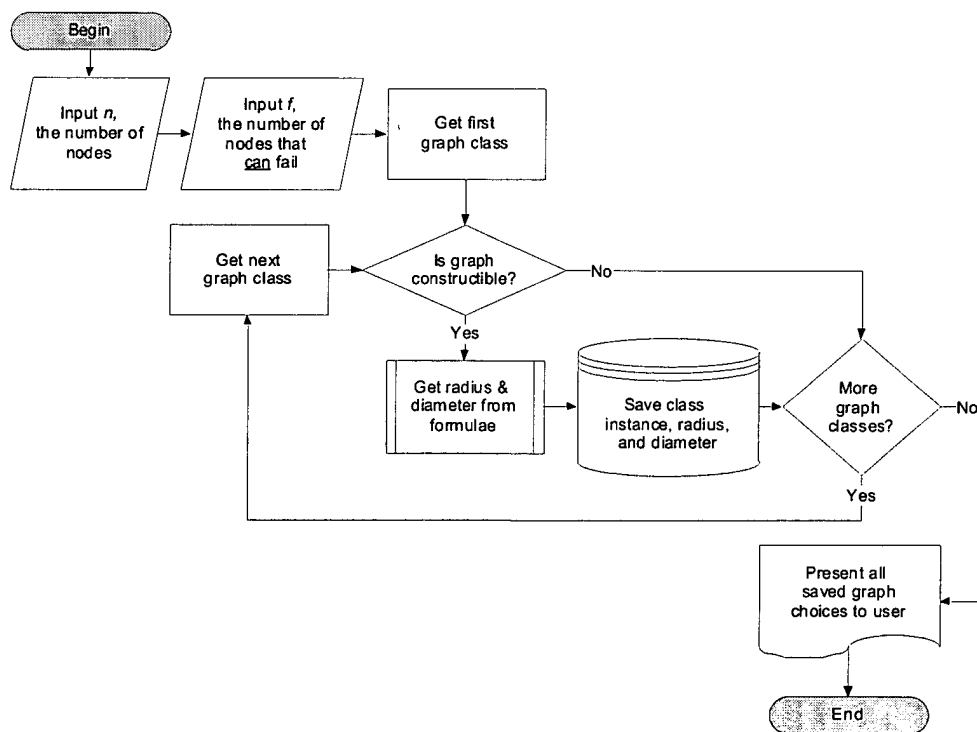| f	p_{wc}	Channels per Node	Channel Count	Applied to the Hypothetical GovNet Traffic Set, The Invention Synthesizes	Minimax Diameter	
					$\leq f-1$	at f
0	1.14%	1.99	87	88 node star S_{88}	N/A	2
1	2.27%	2	88	88 node cycle C_{88}	44	86
2	3.41%	3	132	1D binary K-cube-connected cycle, 44 nodes / cycle	24	44
3	4.55%	4	176	2D binary K-cube-connected cycle, 22 nodes / cycle	14	23
4	5.68%	5	220	3D binary K-cube-connected cycle, 11 nodes / cycle	9	13
5	6.82%	6	264	(3, 3) Chordal cycle	At least 15	
6	7.95%	7	308	(3, 1, 3) Chordal cycle	At least 8	
7	9.09%	8	352	(4, 4) Chordal cycle	At least 11	
8	10.23%	9	396	1D 8-ary K-cube-connected cycle, 11 nodes / cycle	7	11
9	11.36%	10	440	(5, 5) Chordal cycle	At least 9	
10	12.50%	11	484	(5, 1, 5) Chordal cycle	At least 7	
11	13.64%	12	528	1D 11-ary K-cube-connected cycle, 8 nodes / cycle	6	8
16	19.32%	17	748	(8, 11) locally spared 2D K-mesh, mixed radix	*Best possible 3*	

FIG. 4

$$\lim_{D_K \to \infty} \frac{\Delta^+_{m,j,d}}{\Delta^-_{m,j,d}} = \frac{\rho^-_{m,j,d}}{\rho^-_{m,j,d}} = 1$$

A

B

FIG. 5

FIG. 6